International Journal of Dental Sciences
www.dentaljournal.in
E-ISSN: 2663-4708, P-ISSN: 2663-4694
Received: 19-08-2025; Accepted: 18-09-2025; Published: 03-10-2025
Volume 7, Issue 4, 2025, Page No. 15-18

Management strategies for separated endodontic files: Two case reports

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Abstract

Background: Separation of endodontic instruments is one of the most frequent procedural complications in root canal therapy. A fractured fragment may obstruct access to the apical third of the canal, hindering effective debridement and disinfection, and thereby jeopardizing treatment success.

Case Report: This paper presents a 2 case reports with separated instruments located at different levels within the middle and apical thirds of mandibular molars. Following radiographic and clinical evaluation, staging of the canal orifice was performed. Retrieval of the separated instruments was achieved using ultrasonics under dental operating microscope. After successful removal, chemomechanical preparation and obturation were completed to the full working length, followed by appropriate post-endodontic restorations.

Results: Both the cases showed favorable clinical and radiographic outcomes. Patient satisfaction was high, with preservation of tooth integrity and functionality.

Conclusion: Successful management of separated instruments depends on accurate case evaluation, proper use of advanced armamentarium, and operator expertise. Ultrasonics under microscope enables efficient and safe retrieval, while preservation of radicular dentin remains essential for long-term prognosis.

Keywords: Separated instrument, ultrasonics, retrieval

Introduction

According to the American Association of Endodontists, more than 15 million root canal treatments are performed annually [1]. Despite advances in techniques and instrumentation, separation of endodontic instruments remains a significant procedural complication. Such fractures may occur due to torsional stress, cyclic fatigue, or manufacturing defects [2], with an incidence ranging between 0.25% and 6% [3].

A separated instrument (SI) can compromise the outcome of root canal therapy by blocking access to the apical third, limiting chemo-mechanical debridement, and hinders the concept of hermetic seal. To restore complete canal patency, clinicians must either retrieve or bypass the fragment [2]. The success of SI management depends on multiple variables, including canal anatomy, instrument design, and the location of the fragment. Retrieval is more predictable when a gap exists between the fragment and canal wall, and is generally easier in maxillary and anterior teeth compared to posterior or mandibular teeth [4]. Fragments located in the coronal third are more favourable to retrieval because of enhanced visibility and reduced risk of dentin removal [3].

Instrument type also influences retrieval outcomes. Hedström files are more difficult to extract than K-files due to deeper dentin engagement [5], while design features such as greater rake angles, helix angles, and deep flutes further complicate the process [6]. Rotary NiTi files pose additional challenges, as they tend to thread into canal walls and may fracture further under ultrasonic vibrations. Successful retrieval requires clinical persistence, systematic technique, and operator expertise. Experienced clinicians can often achieve removal while preserving radicular dentin [8]. However, when retrieval exceeds the practitioner's capability, timely referral is essential to avoid further complications. Patients must also be informed of risks, alternatives, and prognosis, with written consent obtained prior to intervention [1].

This paper presents two clinical cases highlighting strategies for effective management of separated instruments.

Case report 1

25-year-old female patient reported to the department of conservative dentistry and endodontics with a chief complaint of pain in the lower right back tooth region for past 10 days and relieves on taking medication. The tooth was tender on vertical percussion. An Intraoral Periapical (IOPA) radiograph (fig; 1.a) of the tooth revealed radiolucency involving pulpal space and calcified canal seen in the mesio lingual canal of 37. Based on the clinical and radiographic analysis, it was diagnosed as Irreversible pulpitis with Apical periodontitis.

After applying local anaesthesia, rubber dam was placed around a single tooth #37. The access cavity was prepared with no2 round bur and access opening bur (Dentsply) to refine the cavity. Three canals were negotiated mesio-buccal, mesio-lingual and distal. The working length of the canal was established and confirmed using K-file #10 except mesio-lingual canal as it was calcified. Repeated

instrumentation in the calcified canal leads to separation of instrument separation (K-file #10 and F1 protaper gold). A radiographic examination showed that the instrument's location was in the middle third of the mesio-lingual canal (2.b, 2.c).

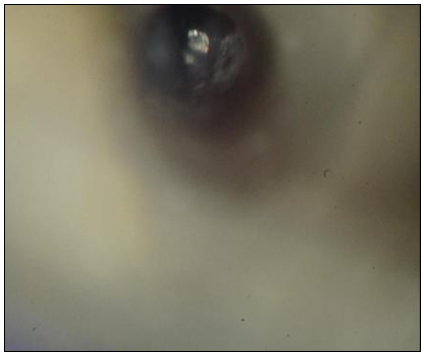
On microscopic examination it showed both the instruments were separated horizontally and tangled upon each other. The patient was informed about the incident, and the treatment plan included the removal of the fragment. Coronal flaring was done and the gates glidden was modified by cutting the tips perpendicular to the long axis of the bur's cross sectional. After that, staging platform was created with the modified gates glidden drills size 1,2,3 (dentsply maillefer, Balaguer, Switzerland).

Ultrasonic tip ED 87 (woodpecker) was used to retrieve the file under dental operating microscope (Zeiss, Pico). Copious irrigation was done with saline and 5.25% sodium hypochlorite. Then the file popped out of the canal (2.d). A radiograph was taken to confirm the retrieval of the file fragment. The retrieved fragment was 2mm (K-file #10) and 3mm (F1).

After instrument retrieval, working length was determined with RVG and electronic apex locator (Root ZX, J Morita) (fig; e). Biomechanical preparation was done using rotary file (Protaper gold, Dentsply Maillefer) upto F1 in mesio-buccal and mesio-lingual canal and till F2 in distal canal. Mastercone check was seen in RVG (fig; f) After 5 days, tooth was obturated with gutta-percha and AH Plus sealer (Dentsply Detrey Gmbh, Konstanz, Germany) (2.g).

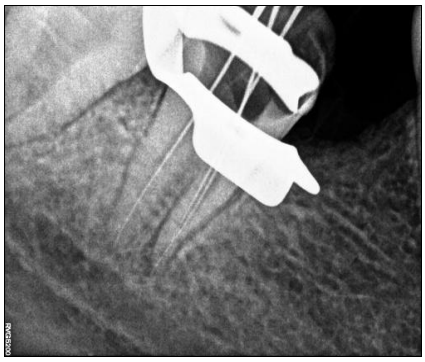
(1a)

(1b)

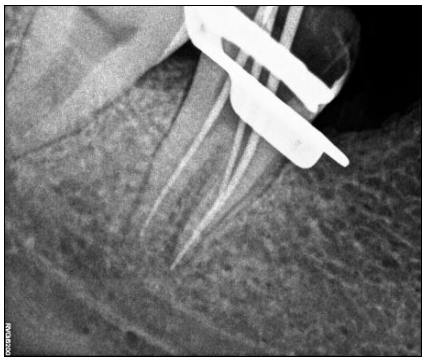


(1c)

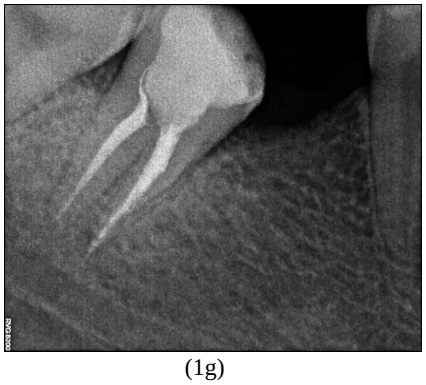
(1d)



(1f)



(1e)



(1g)

Case report 2

A 30-year-old male patient reported with the chief complaint of pain in the lower right back tooth region in the last 1 month. The pain was mild and intermittent in nature, which aggravated mastication. He gave a history of incomplete root canal treatment in the right mandibular first molar and experienced pain a few days after undergoing endodontic therapy (incomplete). Intraoral examination reveaded a temporary/provisional restoration with tooth #46 and revealed separated instrument in the mesiobuccal canal (2.a). Based on the history and the clinical and radiographic examination, a diagnosis of Symptomatic apical periodontitis was made and according to AAE, 2013 this was categorized under "Previously Initiated Therapy."

The instrument was found to be separated from middle third to apical third of the canal. A staging platform was created

using a Gates Glidden bur (size #2; Dentsply-Maillefer) to expose the tip of the separated fragment in the MB canal. An ultrasonic tip ED87 (woodpecker) was used to retrieve the separated instrument (2.b). While trying to retrieve the separated instrument secondary fracture occurred of separated instrument inside the canal, which was then retrieved with same ultrasonic tip and copious irrigation with saline, NaOCl and 17% EDTA liquid. Ultrasonic tip was was used in intermittent frequency and 10-20% of its energy capacity. The separated instrument was 9mm including the secondary fracture (2.c).

The working length was determined radiographically (2.d) and confirmed with electronic apex locator (Root ZX, J Morita), and the canal was prepared using the Protaper gold system (Dentsply Maillefer) to size F2 in distal canal and F1 in mesiobuccal and mesio lingual canal, with copious irrigation of 5% NaOCl solution followed by 17% EDTA. Mastercone check was done (2.e) and the canals were dried and obturated using single cones and AH-plus sealer (2.f) (Dentsply Detrey Gmbh, Konstanz, Germany)

The access cavity was immediately sealed with glass ionomer restorative material and then replaced one week later by a composite restoration.

(2a) (2b) (2c)

(2d) (2e) (2f)

Discussion

Instrument separation is most commonly encountered in molars, particularly within the mesiobuccal roots [10]. Management strategies for a separated instrument (SI) include either bypassing the fragment to maintain working length or limiting cleaning, shaping, and obturation up to the coronal extent of separation [11]. Advances in retrieval techniques have made the removal of fractured instruments more predictable and less invasive [12].

A variety of approaches for SI retrieval have been reported, including the Masserann kit, Endo Extractor, wire loop technique, and ultrasonic systems [13]. In the present report, fractured instruments at different canal levels were successfully removed. The use of magnification devices such as a dental operating microscope (DOM) or surgical loupes improves visualization, reduces unnecessary dentin removal, and enhances prognosis. Factors influencing retrieval include the canal curvature, fragment depth, instrument type, and degree of exposure. Removal is often simpler when the fragment is located in a straight canal portion and at least one-third of its length is exposed [14]. Nevares *et al*. demonstrated that the retrieval success rate rises significantly when fragments are visible under DOM (85.5%) compared with non-visible fragments (47.7%) [11, 14]. Conversely, fragments located beyond a curvature present greater difficulty, and NiTi instruments are less predictable to retrieve than stainless steel files because they are more susceptible to secondary fracture from heat accumulation.

Ultrasonics, first introduced to endodontics in 1957, remain a fundamental tool for SI removal. Earlier devices functioned at 25–40 kHz, whereas newer handpieces operate at 1–8 kHz, producing less shear stress and minimal canal wall alteration [15]. In these cases, removal was achieved using ED87 Woodpecker tips, which provide a tapered, linear design suited to endodontic applications. To minimize procedural risks, ultrasonics should be applied at low-to-medium power, intermittently, and in a dry field under DOM for optimal visualization. Although ultrasonic energy may produce heat leading to fragment fatigue or further fracture, controlled power settings and short activation cycles reduce these risks [16, 17].

While some studies indicate little difference in outcomes between cases with retained and retrieved fragments, the preoperative pulpal and periodontal condition remains a key determinant of prognosis [18]. Above all, conservation of radicular dentin is critical during retrieval. Therefore, the combined use of ultrasonics and DOM, following the preparation of a staging platform, represents a reliable and

minimally invasive method for the management of separated instruments

Discussion

Instrument fracture is more frequently reported in molars, with the mesiobuccal roots being the most commonly affected sites [10]. Management options for a separated instrument (SI) include bypassing the fragment to achieve full working length or restricting cleaning, shaping, and obturation up to the coronal level of separation [11]. With the advent of modern retrieval techniques, instrument removal has become more predictable and less invasive [12].

Several methods have been described for SI retrieval, including the Masserann kit, Endo Extractor, wire loop technique, and ultrasonics [13]. In the present report, fractured instruments were identified at different canal levels and were successfully retrieved. The use of magnification aids such as the dental operating microscope (DOM) or surgical loupes enhances visualization and minimizes unnecessary dentin removal, thereby improving prognosis. Key factors influencing retrieval success include the location of the fragment relative to canal curvature, fragment depth, instrument type, and extent of exposure. Retrieval is often straightforward when the fragment lies in a straight portion of the canal with at least one-third of its length exposed [14]. According to Nevares *et al*., the retrieval success rate is significantly higher (85.5%) when the fragment is visible under a DOM, compared to 47.7% when it is not [11, 14]. Conversely, fragments located apical to the canal curvature are usually more difficult to remove. Stainless steel files are retrieved more predictably than NiTi instruments, which are prone to secondary fracture due to heat accumulation during retrieval.

Ultrasonics, first introduced in endodontics in 1957, remain a cornerstone in SI management. Earlier devices operated at 25–40 kHz, while recent handpieces function at 1–8 kHz, producing reduced shear stresses and minimal canal surface alterations [15]. In the present cases, SI removal was performed using the ED 87 woodpecker tips, whose tips demonstrate a linear and tapered tip, well suited for endodontic applications. To minimize risks, ultrasonic tips should be used at low-to-medium power settings, intermittently, and preferably in a dry field under DOM to improve visibility. While this technique may generate frictional heat, which can induce fatigue or fracture of the fragment, careful power modulation and controlled application reduce such risks [16, 17].

Although some studies report no significant difference in prognosis between cases with retrieved and retained fragments, preoperative pulpal and periodontal status often influences the long-term outcome [18]. Importantly, preserving radicular dentin integrity during retrieval is paramount. Therefore, the combined use of ultrasonics and DOM following the creation of a staging platform is considered a predictable and minimally invasive approach for successful SI management

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